$$RE_k = \left| \frac{\sum_{t_j < t_k - T} d_j}{T} \right| = QE_k$$

FIG. 1

$$RE_{k-1} = \left| \frac{\sum_{t_j < t_{k-1} - T} d_j}{T} \right| = QE_{k-1}$$

FIG. 2

$$d_k - \frac{\sum_{j<=I_k - T, I_j > I_{k-1} - T} d_j}{T}$$

FIG. 3

$$RE_k = RE_{k-1} + \frac{1}{21}(RE_k + RE_{k-1})$$

$$\hat{RE}_k = \frac{19}{21}\hat{RE}_{k-1} + \frac{1}{21}(RE_k + RE_{k-1})$$

FIG. 4

```
if (3 DUPACKs are received)                                    ~502  ~506  ~504
500 ~if (cwin/ ((RE * RTTmin) / seg_size) >θ) /*Congestion condition*/
    505 ~ssthresh = (RE* RTTmin) / seg_size;
        else /* no congestion */                                        ~508
        507 ~ssthresh = (BE * RTTmin) / seg_size;
        endif
509 ~if (cwin > ssthresh) /* congestion avoid. */
            cwin = ssthresh;
        endif
endif
```

FIG. 5

```
if (3 DUPACKs are received)                                    600
        ssthresh = (ABSE * RTTmin) / seg_size;
        if (cwin > ssthresh) /* congestion avoid. */
                cwin = ssthresh;
        endif
endif
```

In case a packet loss is indicated by a timeout expiration, *cwin* and *ssthresh* are set as follows:

```
if (coarse timeout expires)                                    602
        cwin = 1;                                              604
        ssthresh = (ABSE * RTTmin) / seg_size;                 606
        if (ssthresh < 2)
                ssthresh = 2;
        endif;
endif
```

FIG. 6

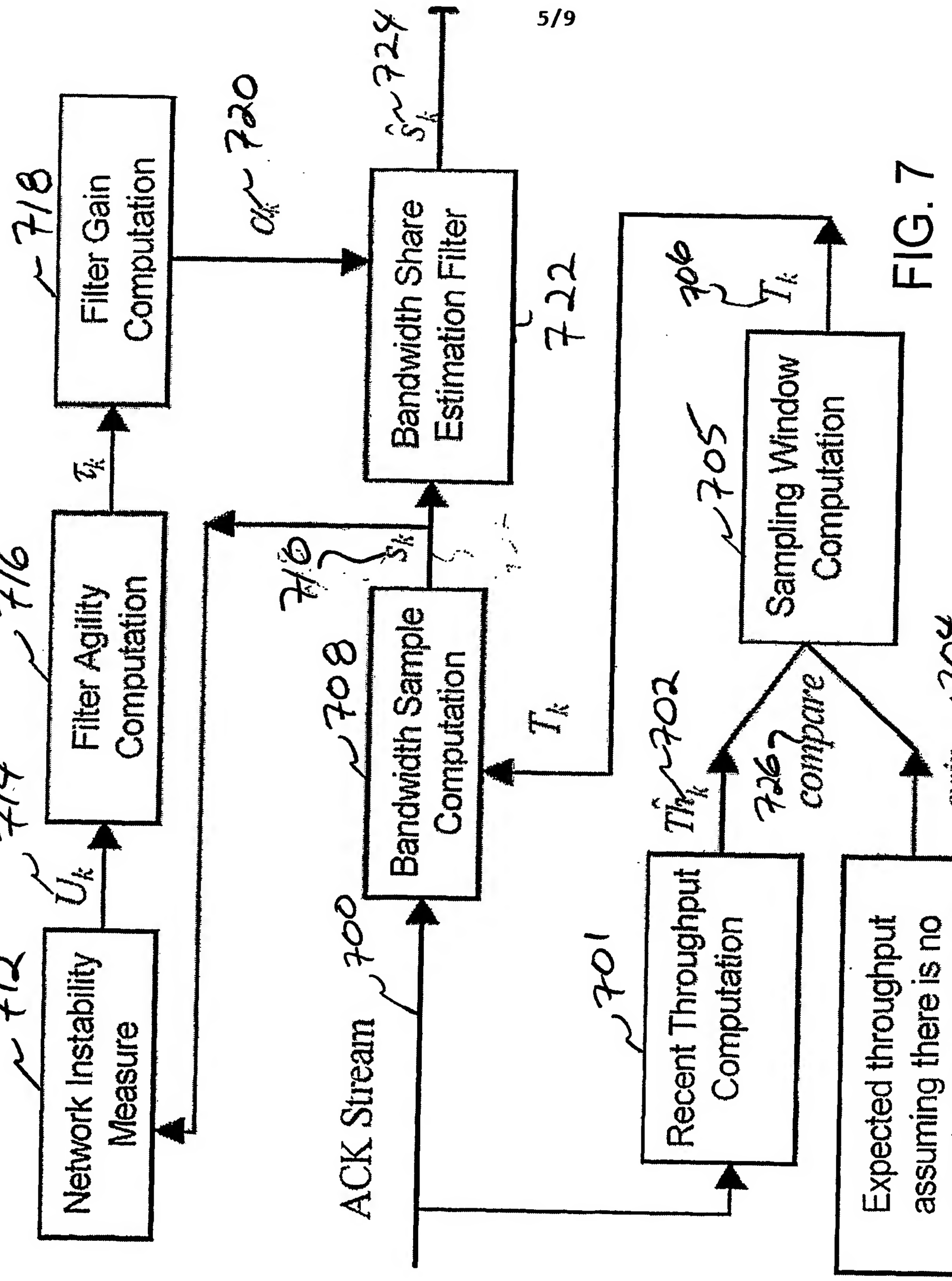
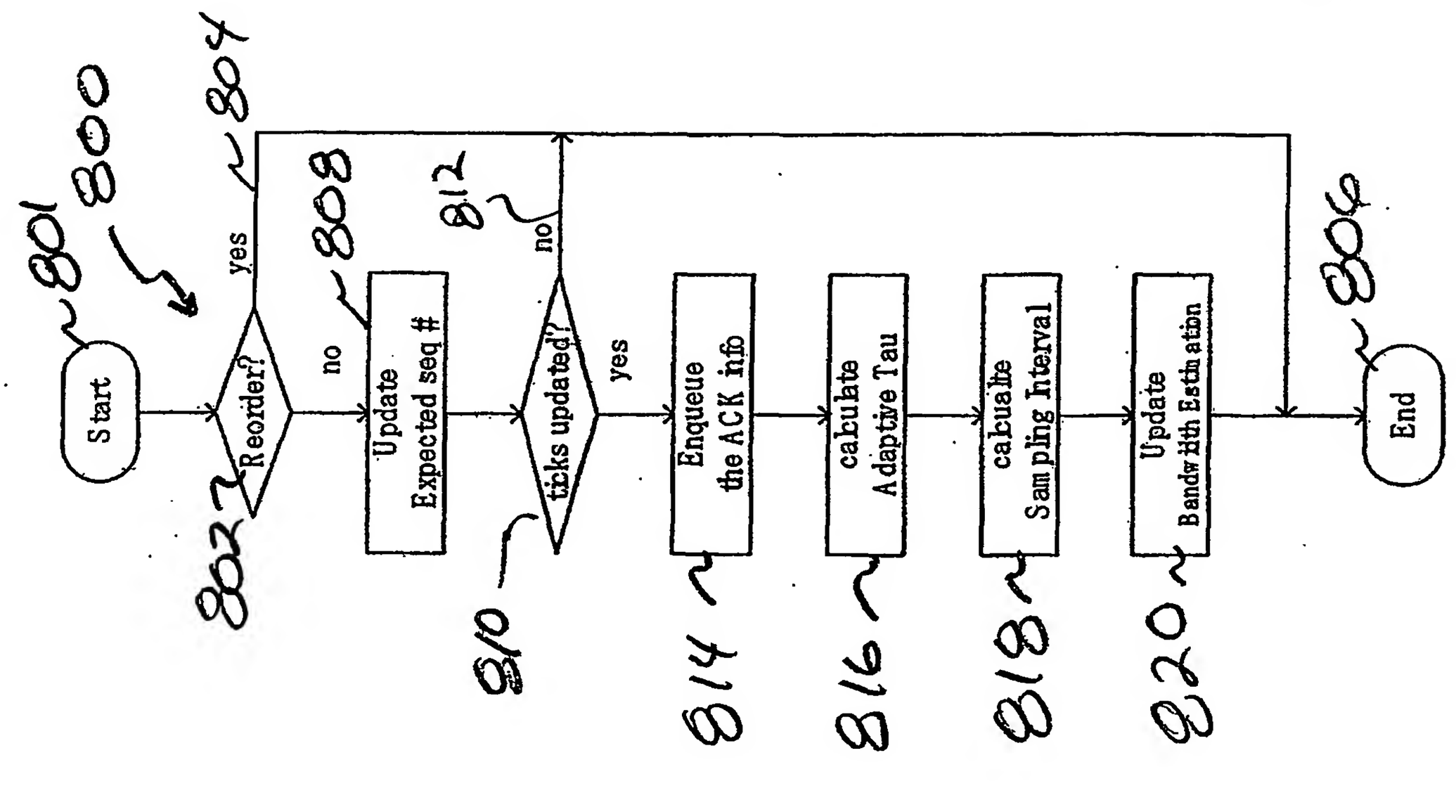

Filter Gain Computation
718
720
Bandwidth Share Estimation Filter
724
722
Filter Agility Computation
716
714
Bandwidth Sample Computation
708
706
Sampling Window Computation
705
Network Instability Measure
712
ACK Stream
700
Recent Throughput Computation
701
compare
726
Expected throughput assuming there is no congestion in the network
703
204
202

FIG. 7

FIG. 8


800
801
802
Reorder?
yes
no
804
End
806
808
Update Expected seq #
810
ticks updated?
yes
812
no
814
Enqueue the ACK info
816
calculate Adaptive Tau
818
calculate Sampling Interval
820
Update Bandwidth Estimation

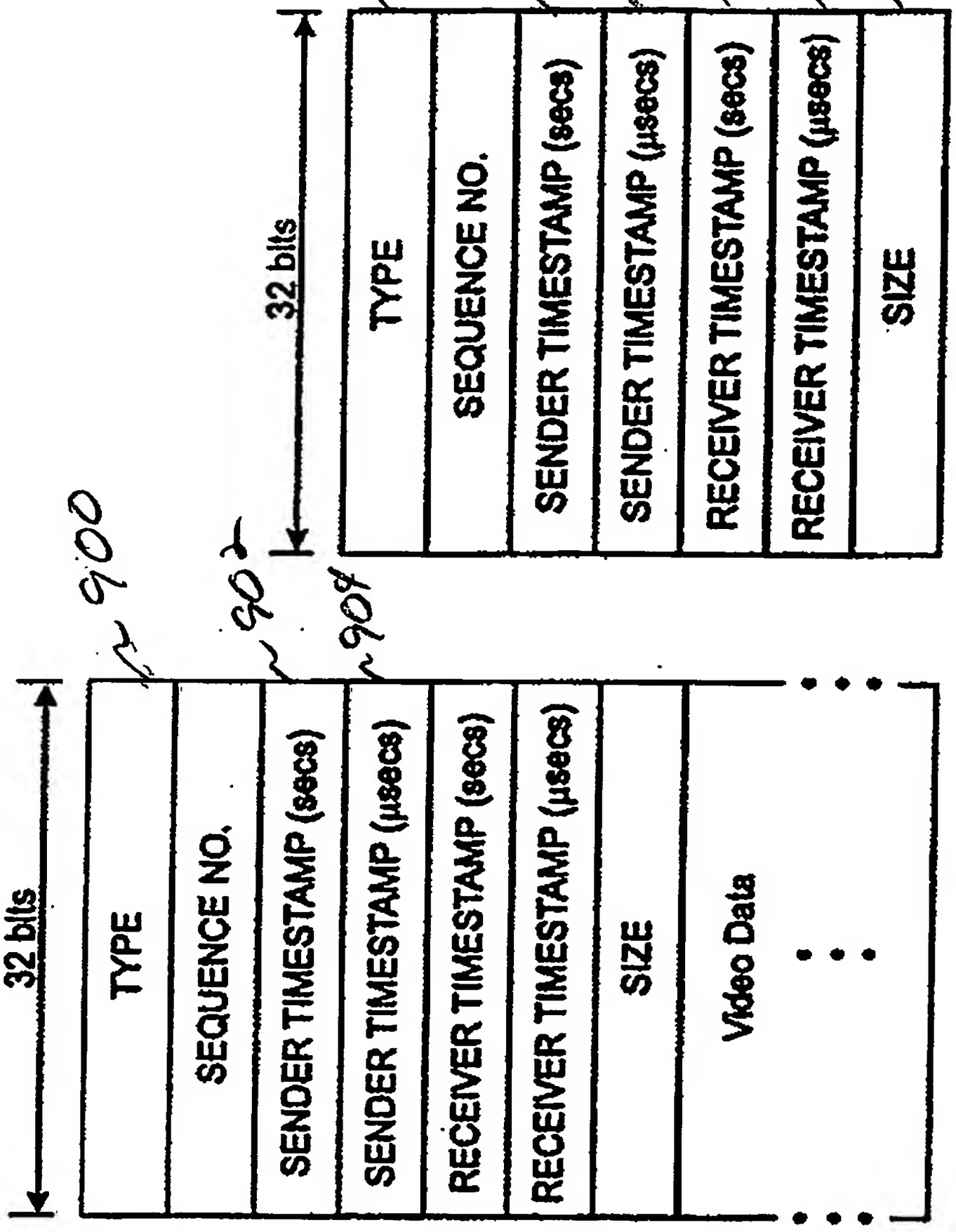

32 bits
TYPE
SEQUENCE NO.
SENDER TIMESTAMP (secs)
SENDER TIMESTAMP (μsecs)
RECEIVER TIMESTAMP (secs)
RECEIVER TIMESTAMP (μsecs)
SIZE
Video Data
900
902
904

FIG. 9

TYPE
SEQUENCE NO.
SENDER TIMESTAMP (secs)
SENDER TIMESTAMP (μsecs)
RECEIVER TIMESTAMP (secs)
RECEIVER TIMESTAMP (μsecs)
SIZE
1000
1002
1004
1008
1010
1006

FIG. 10

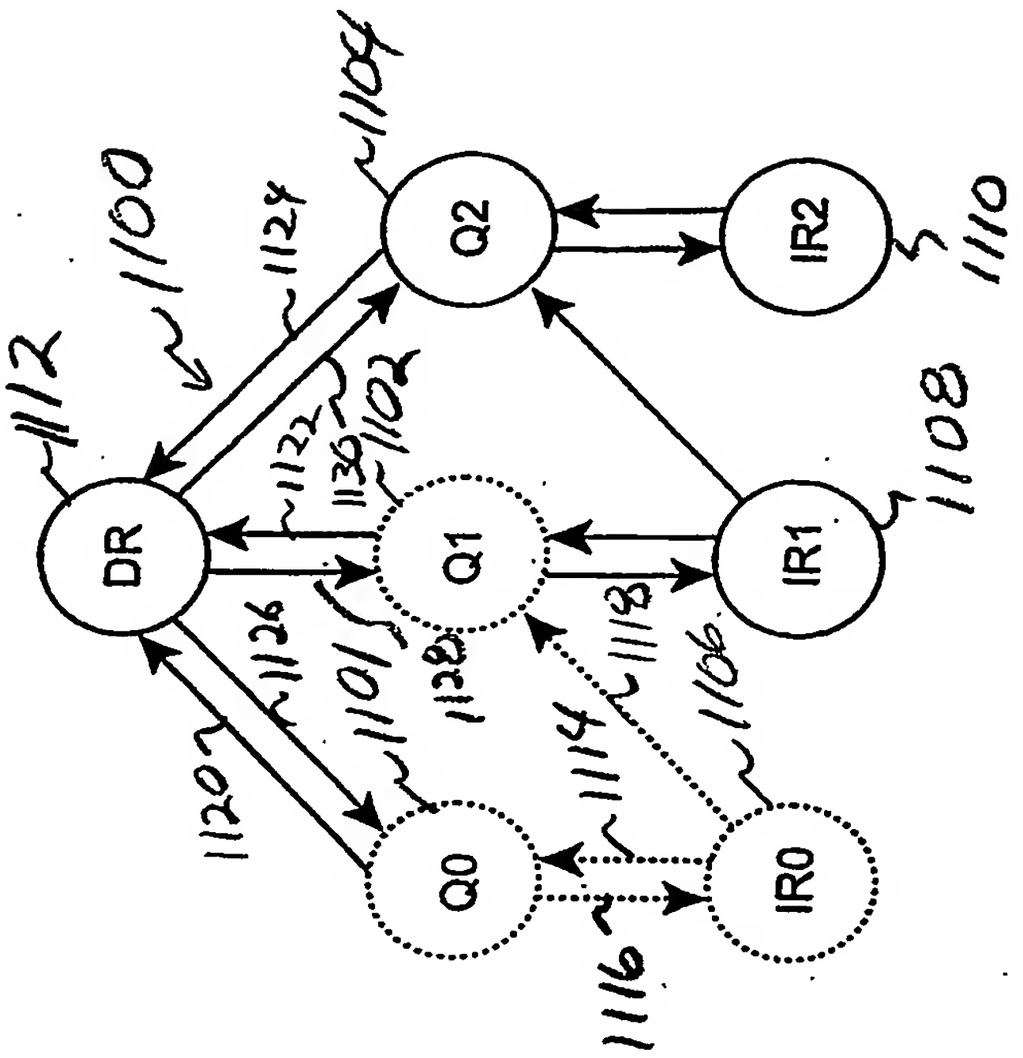

1112
1100
1124
1104
Q2
IR2
1110
DR
1122
1102
1136
Q1
IR1
1108
1126
1101
1128
1120
1114
1106
Q0
IR0
1116

FIG. 11

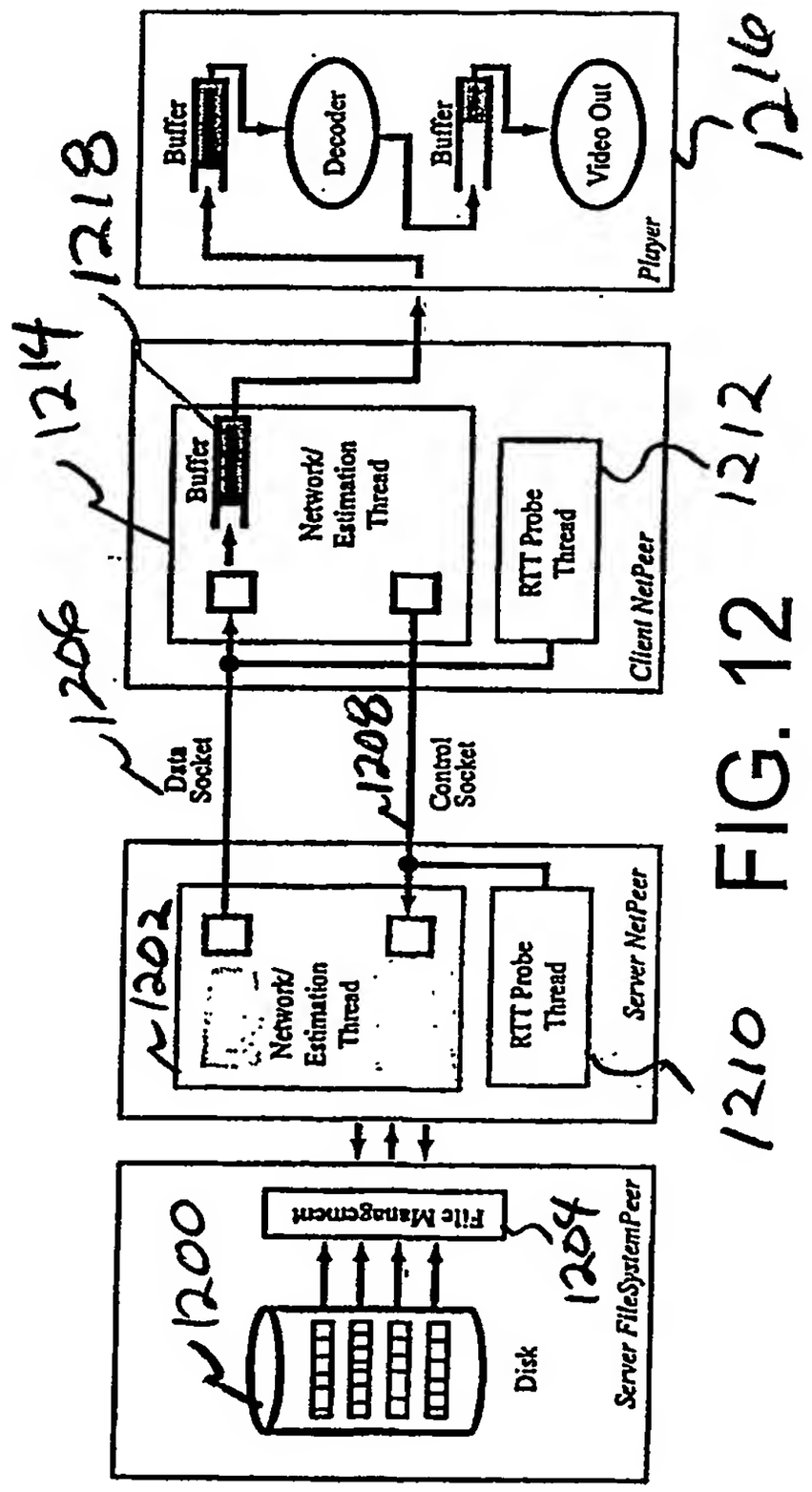

1218
1214
1216
Buffer
Decoder
Buffer
Video Out
Player
1206
Buffer
Network/ Estimation Thread
RTT Probe Thread
Client NetPeer
1212
Data Socket
1208
Control Socket
1202
Network/ Estimation Thread
RTT Probe Thread
Server NetPeer
1210
1200
File Management
1204
Disk
Server FileSystemPeer

FIG. 12

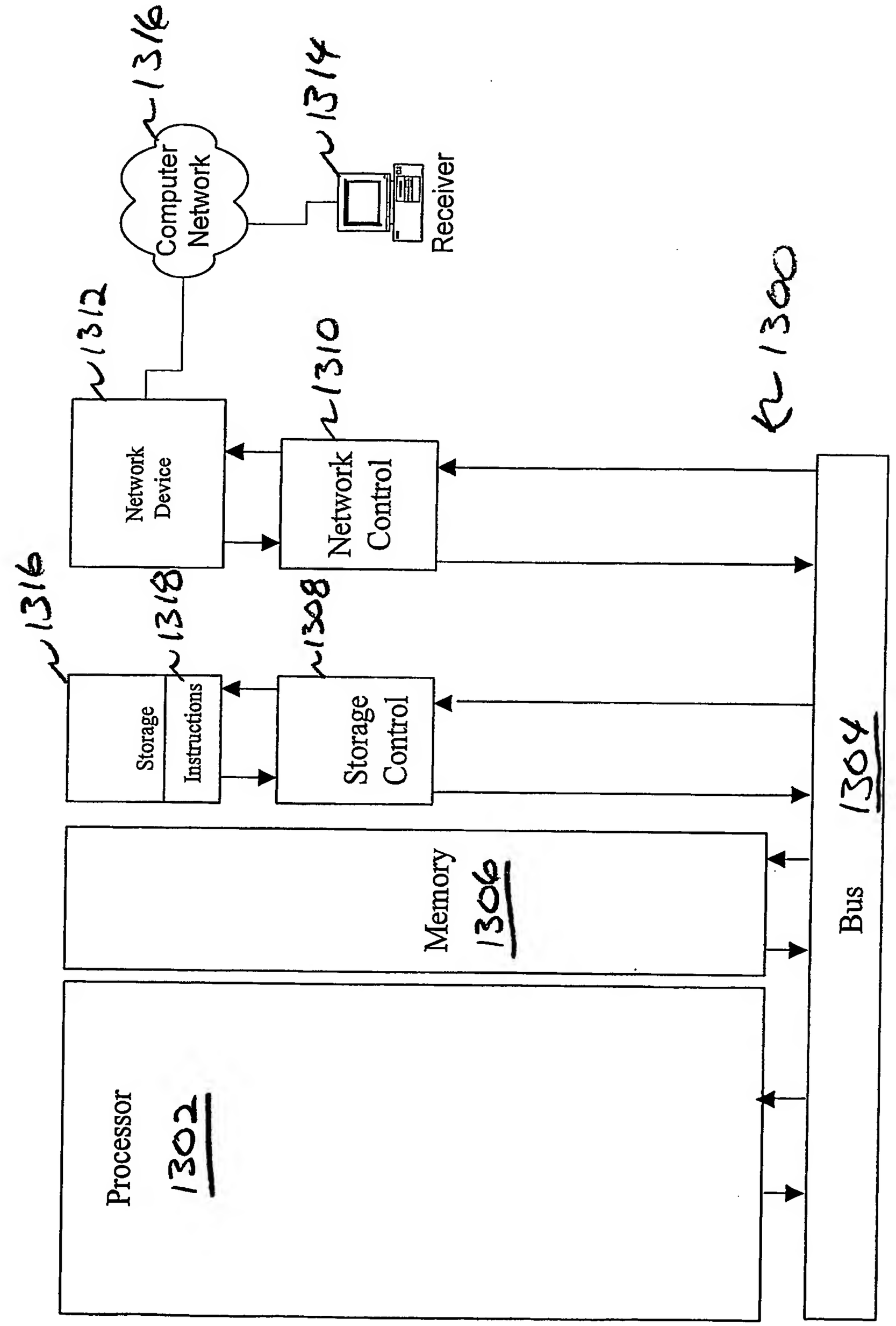

1316
Computer Network
1314
Receiver
1312
1310
Network Device
Network Control
1318
1308
Storage
Instructions
Storage Control
1316
Memory
1306
Bus
1304
1300
Processor
1302

FIG. 13